From Pre-Recorded Tape to Live Computer Processing: Piano Music from Davidovsky to the Present Day

By

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Submitted to the graduate degree program in Music and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Musical Arts.

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Date Defended: 24 January 2018

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Abstract

The 1920s and the 1930s first introduced the implementation of electronic effects to acoustic instruments and since this time the exploration of sound manipulation through electronic means has blossomed. Though technological advancement has always affected the way music is performed and composed, the 20th century has shaped the culture of music drastically, and with the advent of recording technology and electronics, the door to a whole new world of artificially generated and/or electronically manipulated sound has been created. The purpose of this study is to examine the history of technologies relevant to the development of electro-acoustic music and explore how their unnatural sounds and methods of sound production have influenced the development of music in the 20th century and beyond. To answer these questions, this study will incorporate analyses of works composed by Mario Davidovsky, Jacob Ter Veldhuis and Christopher Cerrone, showing some of the ways electro-acoustic composition with piano has evolved over the last fifty years.

Acknowledgements

I would like to express my great appreciation to my advisor, Dr. Michael Kirkendoll, who has also served as my piano professor at the University of Kansas. Throughout my years at KU, he has offered me much insight into the art of piano performance and the experiences and knowledge he has showed to me about the 20th century piano performance. I am also grateful for Dr. Jack Winerock for imbuing in me a more intense and meaningful interest toward new music. I want to express my utmost gratitude toward Dr. Alan Street, Dr. Bryan Haaheim, and Dr. Chris Crandall who have provided assistance and crucial advices to keep this project running in the right direction and giving constructive advices on writing this topic. Finally, I want to acknowledge my family, friends for their unwavering support.

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Chapter I: Approaching Electro-Acoustic Music

Introduction

The advancement of technology in the twentieth century created space for the further development of music and increased demands for new sounds. Many musicians explored these new possibilities through extreme tempo and dynamic changes, extended techniques, extremity of range, and by incorporating other unfamiliar sounds. The piano was well suited for these new techniques and opened many doors to unconventional sounds. Eventually the classical repertoire could not satisfy the curiosity of contemporary pianists and composers. A greater number of musicians explored the sphere of electronic sounds in recordings and live performances. Electronic music festivals established these "new" musicians and creative explorations in this vein were labeled "electro-acoustic." This term was commonly used to describe technologically-produced sounds.

As electronic music emerged from several directions, the music community was confused by the general definition. Composers and authors interested in "new music" coined various terms to identify aspects of electronic music. Considering its broad spectrum, Otto Luening, a pioneer in the field of early tape music defined it broadly.

> Electronic music is a generic term describing music that uses electronically generated sound or sound modified by electronic means, which may or may not be accompanied by live voices or musical instruments, and which may be delivered live or through speakers.[1]

As his definition was too overarching, some members of the music community began to see the lack of specificity in terminology. With the continual advancement of electro-acoustic music and its complexities, other figures created additional terminology. Stephen Travis Pope "contend[ed]

[1] Otto Luening, *The Odyssey of an American Composer: The Autobiography of Otto Luening* (NY: Scribner, 1980), 605.

that calling computer music 'computer music,' or calling electroacoustic music 'electroacoustic music' [was] as meaningless as calling rock and roll 'electric guitar music.'"[2] In *Electroacoustic Music for the Flute,* Sarah Louise Bassingthawigthe states, "It is arguable that the term is really one of aesthetics and not just of terms and the point in the end is to communicate effectively."[3] Therefore, it offers us many opportunities to develop our own ideas about how to define electro-acoustic music. As we examine a brief history and development of electronic music, it is impossible to define electro-acoustic music as a single, simple entity as it is an ever-growing art with infinite capacities.

A Brief Survey of Electronic Music

New technology like the phonautograph, phonograph, telegraphone, and the audion opened the possibility of sound design. The invention of the phonautograph is widely known to mark the beginning of electronic music history. Invented in 1857 by Frenchman Leon Scott de Martinville, the phonautograph was the earliest recording device. It transcribed sound waves onto a cylinder wrapped in a sheet of carbon-coated paper. Twenty years later, Thomas Edison developed the phonograph using similar technology. The phonograph was critical to the development of sound technology because it was the first recording device to reproduce sounds. Using a playback stylus to trace an incised spiral groove while the disc rotated, it produced a very weak copy of the recorded sound. In 1899, Danish engineer Valdemar Poulsen developed the telegraphone, a magnetic-wire recording device. As electro-magnetic devices developed, Lee de Forest introduced a vacuum tube device called the audion in 1906. The audion amplified

[2] Otto Laske, "For Lack of a Better Word By Any Other Name" *Computer Music Journal* 16, no. 1 (1992): 1, https://doi-org.www2.lib.ku.edu/10.2307/3680708.
[3] Bassingthwaighte, Sarah, "Electroacoustic Music for the Flute," (DMA diss., University of Washington, 2002), 2. https://search-proquest-com.www2.lib.edu/docview/251283879?accountid=14556.

electronic signals and paved a path for future electronic developments. Lee's invention was critical to the foundation of the electromagnetic field and he was deemed the "father of radio."

This new technology inspired composers to incorporate electronic sounds into their works and people's taste in music started to change. The Italian composer Ferruccio Busoni published the *Sketch for a New Aesthetic of Music* in 1907 outlining his perception of the future of music.

> Music as art, our so-called occidental music, is hardly four hundred years old; its state is one of development, perhaps the very first stage of a development beyond present conception. And we talk of 'classics' and 'hallowed traditions'! And we have talked of them for a long time!
>
> We have formulated rules, stated principles, laid down laws — we apply laws made for maturity to a child that knows nothing of responsibility! This child-music-it floats on air! It touches not the earth with its feet. It knows no law of gravitation. It is well-nigh incorporeal. Its material is transparent. It is sonorous air. It is almost Nature herself. It is free![4]

Busoni's ideas influenced many musicians and encouraged them to explore the spectrum of sound in unique and creative ways. As people began to explore more unconventional sounds, these strange and "new" sounds became more accepted.

Electronic amplification capability increased, opening a new avenue of exploration. In 1928, Lev Sergevevich Theremin and Maurice Martenot each invented an instrument designed for a conventional use and both implemented novel forms of performer interfaces. A performer plays the theremin by moving their hands in the space around a pair of metal antennas. The Ondes Martenot player uses a special keyboard with their right hand to determine pitch and manipulates a set of buttons and levers with their left hand to articulate the tone. Electronic technology and music started to coincide and many composers, including Olivier Messiaen,

[4] Ferruccio Busoni, *Sketch of a New Aesthetic of Music*, Quoted in Herbert Russcol, *Liberation of Sound: An Introduction to Electronic Music* (Englewood Cliff, NJ: Prentice-Hall, 1972), 34-36.

Darius Milhaud, Joseph Schillinger, Richard Strauss, and Leopold Stokowski, utilized these instruments in their works.

As technology advanced, people discovered the possibilities of audio recording and play back. The German electronic company AEG (Allgemeine Elektrizitäts Gesellschaft) built the magnetophon using the principles of magnetic tape invented by Fritz Pleumer. This device employed magnetic tape to record and play back audio samples. By the 1930s, many composers started to use recording technology in their compositions, relying heavily on synchronism techniques such as adjusting speed and delaying feedback. Other types of synchronism included sampling, which is recording and playing back the captured sounds, and synthesis, where both pure electronic sound design and samples are used as a basis for modulated audio form. As sampling techniques became more advanced, sound manipulation and synthesis became more complex. Techniques such as superimposition of multiple tape sounds, alteration of timbre through high and low filters, and delay tracks through looped samples became highly prevalent and tape recordings were spliced to adjust the attack and decay. Composers then rearranged these samples to create new musical sounds. Even the speed of the tape could be adjusted to change the pitch and its reversal created additional options for the composers to use in the creative process.

Pierre Schaeffer, a French composer, engineer, and broadcaster, developed *musique concrete*. This experimental technique used recorded sounds as raw material in musical compositions by assembling various natural sounds recorded on tape to produce a montage of sound.[5] The first movement of Schaeffer's composition *Cinq etudes de bruits* (1948) features pre-recorded sounds of musical instruments, vocal sounds, and environmental sounds to capture

[5] *Encyclopaedia Britannica Online*, Academic ed., s.v. "Musique concrete," accessed January 17, 2018, https://www.britannica.com/art/musique-concrete.

spatial atmosphere in performance. Schaffer uses techniques beyond the rules of music theory and pure electronic sounds by integrating synthesizers and computer-based digitally processed sounds. In 1942, Schaeffer founded the *studio d'Essai* where many composers gathered to collaborate and experiment. Ultimately these explorations paved a path for future tape music and further synthesis. Sampling, digital processing, and synchronism are present in all genres of music, films, advertisements, and any other products that require sounds.

In 1951, Herbert Eimert, Werner Meyer-Eppler, and other composers established a studio for *Elektronische Musik* in Cologne, Germany under the auspices of the Northwest German Broadcasting Studio.[6] While the composers utilized many of the same tape manipulation techniques their French colleagues, the composers working in Germany favored synthetically produced sounds rather than naturally occurring ones. In particular, they synthesized complex tones from sine wave forms (pure tones with no overtones). Karlheinz Stockhausen is also associated with this studio and several of his works, including the *Gesang der Jünglinge (Song of Youth)* (1955-1966), are representative of the techniques employed in the Cologne studio. Musicians began to combine waveforms to create various types of digitally based sound waves such as the saw, triangle, and square. In combination with the use of lo-pass and hi-pass filters, the capability of synthesis became limitless. To formulate synthesis in a functional and ergonomic way in performance, the synthesizer was created. A synthesized sound may resemble a traditional acoustic musical timbre or it may be completely original. Even though sounds can be generated by technology, the relationships among sounds throughout all synthesized music are "designed" or "composed" by a musician.

In 1932, Armand Givelet and Edouard Coupleux invented the first synthesizer in France. They replaced organ pipes with vacuum tube oscillators and used punched paper rolls as a

[6] At the time, Cologne was part of West Germany.

controller. This instrument was designed to be a cheap replacement for a pipe organ but was discontinued due to the popularity of the Hammond organ. Created by an American engineer Laurens Hammond, the Hammond organ is similar to the telharmonium (an early electronic organ) and was deemed its successor, as the Hammond organ was a commercial instrument. In 1950, Harry Olson and Herbert Belar designed an advanced score-reading instrument called the RCA Electronic Music Synthesizer. Although it was an attempt to create a hit maker, these electrical engineers inadvertently created one of the first synthesizers, the Mark 1 (MK1). Although the MK1 and the MK2 (Mark 2) had millions of settings, they eventually became obsolete and fell into obscurity with the introduction of solid-state transistor technology including the Buchla and Moog synthesizers.

In the early 1960s, the Italian engineer Paolo Ketoff invented the Synket (or Synthesizer-Ketoff). He introduced the Synket to American composer John Eaton, who recognized the possibilities of using synthesizers in live performance to rely on prerecorded sounds.[7] In 1964, Robert Moog and Donald Buchla's synthesizers were introduced. These instruments differed primarily in the control interfaces they offered. The Moog instrument's key feature was the conventional keyboard controller that was more convenient in the performance of traditional classical music. Buchla's instrument had touch-sensitive contact pads that could be used to initiate sounds and sound patterns. Both the Moog and Buchla were widely employed by experimental composers, especially Morton Subotnik, whose compositions *Silver Apples of the Moon* (1966), *The Wild Bull* (1967), and *Sidewinder* (1970) appeared on long-playing records. Although the difference in the controllers of the Moog and Buchla created different user-friendly ways to perform music live, these key analog synthesizer parameters completely changed the

[7] Elliott Schwartz, *Electronic Music: A Listener's Guide* (New York : Praeger, 1975), 347.

capabilities of synchronism and synthesis. Pitches, tone colors, vibrato intensities, envelope shapes, and portamento were routed internally with easily accessible knobs. Some analog synthesizers included oscillators to generate repetitive waveforms, mixers to combine waveforms, amplifiers to shape the volume contours of the sounds, and compressors to increase the strength of some overtones while reducing the strength of others. Other sound-producing and -processing elements existed within the electronic circuits as built-in computer programs. Synthesizers eventually contained controllers made from any combination of conventional keyboard, open parameters, wheels, sliders, joysticks, electronic pattern generators, or digital audio workstations (DAW) to facilitate control of musical elements.

Although these innovations are only a few examples, it is clear that musicians incorporated various creative elements to pursue electronic music performance with synthesis. In the pursuit of creativity, many composers opened doors to the incredible possibilities of sound manipulation and design. Works by Mario Davidovsky, Jacob ter Veldhuis, and Christopher Cerrone offer insight into how new techniques made possible by emerging technology in the twentieth century were used by these composers in compositions and performances.

Chapter II: Mario Davidovsky: *Synchronisms no. 6*

Background and Biography

Mario Davidovsky was born in Buenos Aires, Argentina, on 4 March 1934. He started learning violin at age seven, began composing at age thirteen, and attended the University of Buenos Aries where he studied theory and composition with Guillermo Graetzer. In 1958, Davidovsky attended the Berkshire Music Festival at Tanglewood and while studying with Milton Babbitt and Aaron Copland he developed an interest in electro-acoustic music. After encouragement from Copland, Davidovsky relocated to the United States permanently in 1960 and worked at the Columbia-Princeton Electronic Music Center, becoming the director in 1981.

In addition to composing, Davidovsky was a brilliant and a successful teacher. He taught at several institutions including the University of Michigan (1964), Manhattan School of Music (1968-69), Yale University (1969-70), and the City College of the City University of New York (1968-80). In addition to teaching, Davidovsky received numerous awards including The American Academy of Arts and Letters' Academy Award (1965), and The Society for Electro-Acoustic Music in the United States (SEAMUS) Lifetime Achievement Award (1989). His best-known composition, *Synchronisms no. 6* from his series of synchronisms, won the Pulitzer Prize in Music in 1971.

Davidovsky composed *Synchronisms no. 6* for the American pianist Robert Miller while at the Columbia–Princeton Electronic Music Center. In 1970, the composition was performed at the Tanglewood Contemporary Music Festival and the Pulitzer jury awarded the piece the Pulitzer Prize in Music the following year, declaring that the piece showed mastery of a new

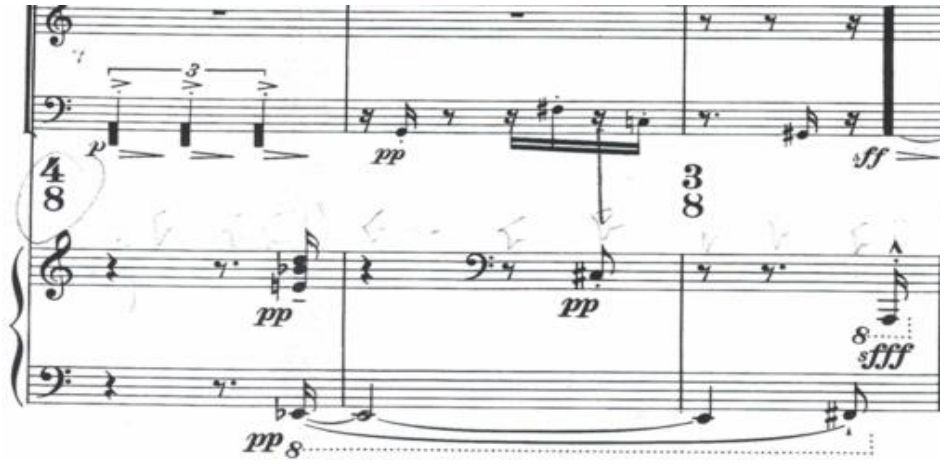
medium and its imaginative use in combination with the solo pianoforte.[8] *Synchronisms no. 6* is part of a series of compositions that combined electronically-synthesized sounds with conventional instrumental elements. In many instances, the synthesized sounds mimic the acoustical characteristics of the piano and cause timbral exchanges that altered the typical decay and attack of the piano sounds.

Overview

Davidovsky created a complex interplay between the piano and synthesized tape sounds through a high-quality stereo playback system using speakers placed near the piano. The duration of *Synchronisms no.6* is 7'30". The score often includes a line for the tape notated above the piano part. Some of the measures contain specific pitch and rhythmic notations for the tape sounds and others provide graphic notations. The tempo is marked at the very beginning of the piece "♪=120 exactly," and the success of the performance is attributed to the synchronization of the pianist with the tape playback.[9] The performer must match and observe all tempos, rhythms, rests, dynamic, and sounds precisely. For example, the piano and tape alternate in measure two between sixteenth notes and eighth notes as shown in Figure 1.

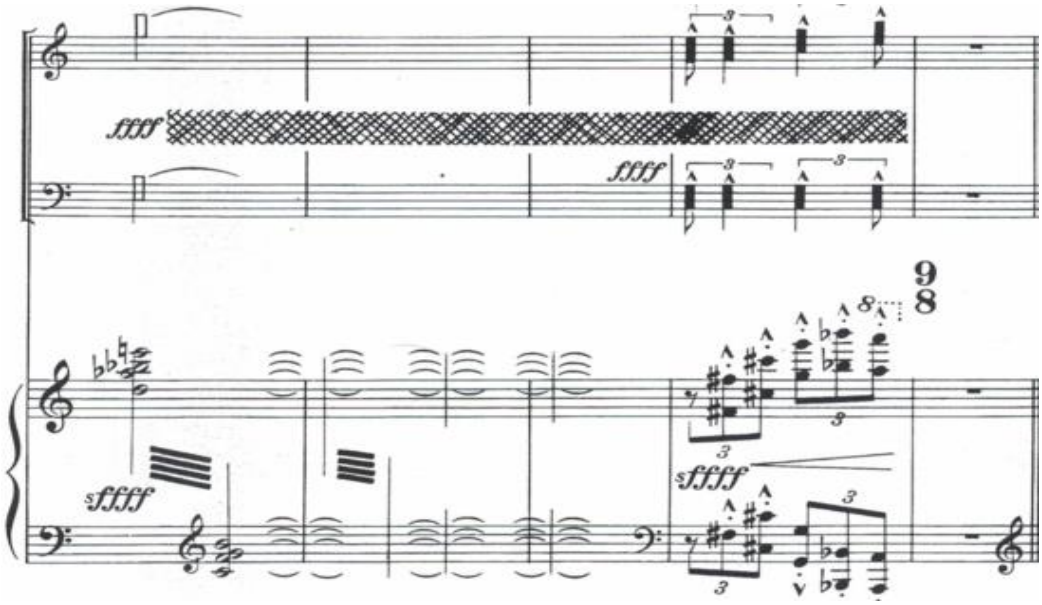
[8] John Hohenberg, *The Pulitzer Diaries: Inside America's Greatest Prize* (Syracuse, NY: Syracuse University Press, 1997), 150.
[9] Mario Davidovsky, *Synchronisms No.6, for Piano and Electronic Sounds* (NY: E. B. Marks Music Corp., 1972).

Figure 1: *Synchronism no. 6*, pg. 4, system 1, m. 2



In other measures, the notation provided in the piano part indicates imitation of the tape rather than precise rhythmic and dynamic alignment. The tremolos that Davidovsky used in the piano part imitate the machine-like sound illustrated by the graphic notation in the tape part as shown in Figure 2.

Figure 2: *Synchronism no. 6*, pg. 20, s. 2, mm. 1-4



Form

The formal structure of *Synchronisms no.6* is very important, as it is clearly outlined by each fermata sign. The form is divided into seven sections and Davidovsky embedded traditional sonata form ideas within the piece. The opening sustained G appears in the piano and tape part as an exposition and later reappears in measure 93. This sustained G functions as recapitulation. The repetition of the sustained G appears with additional tremolos and triplets to enrich the texture and connect the whole piece together. Davidovsky also combined the textural variations with the tension release technique to highlight this piece's individual formal units. The general formal divisions are outlined in Table 1.

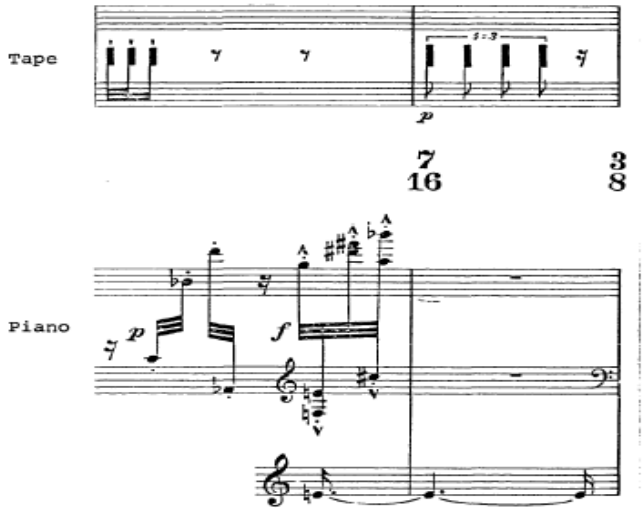
Table 1: Form of *Synchronism no. 6* by Mario Davidovsky

Section	Measures	Characteristics
I	Mm. 1-19	Piano and tape interplay introduced with many languid lines and sustained notes within a thin texture
II	Mm. 20-43	The rhythm becomes more active with additional layers of sound sonorities; the synchronized sound alternates with free harmonies, uses more rich timbres than section one
III	Mm. 44-66	Frequent use of sharp accents in both the piano and tape collaborate and support each other; short motivic ideas used in both parts; texture is polyphonic and becomes thicker
IV	Mm. 67-92	Texture becomes more homophonic, heightens tension; he beginning active surface rhythm after a languid line leads to a passionate, tense section
V	Mm. 93-135	Begins with opening material with a lighter sound; music gradually increases in intensity and activity pushs to the climax of work; texture also changes with dynamics from thin to thick creating more tension
VI	Mm. 136-155	Long piano cadenza and peaceful part introduces the final section; the short tremolo motive comes back again at a very soft dynamic level in combination with extended techniques played inside the piano
VII	Mm. 156-165	Extended techniques used again

Rhythm

The rhythmic relationship between piano and tape in *Synchronisms no.* 6 is comparable to the relationship between the pianist and the orchestra during a concerto. While in a concerto, the soloist, conductor, and the orchestra are able to coordinate through non-verbal communication, performing with a tape does not allow for a similar type of flexibility. The ability to facilitate *ad libitum* within the limits of invariable tempo is a performance challenge of *Synchronisms no.* 6 that ultimately increases the virtuosity of the piece. Davidovsky provides the precise rhythmic coordination between two parts to create dialog-like phrases shown in Figure 3.

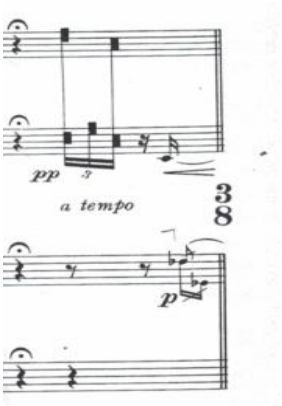
Figure 3: *Synchronism no. 6*, pg. 14, s. 2, mm. 3-4



Synchronisms no.6 requires the pianist to change tempo freely but does not contain the same changes in the tape parts. Even though the piece is based on an eighth-note pattern, it lacks stability with the constant meter change (e.g. use of 3/8, 7/8, 4/8, 5/16, 5/8, 4/4). The elaborate rhythm creates space and change with the use of fermatas in both parts. After each fermata, the tape part includes a cue for the piano to rejoin on time. These fermatas appear in mm. 6, 20, 47,

71, 99, 141, and 160. In addition, Davidovsky uses a short triplet motive to connect all of sections. An example of this motive at the end of section one is shown in Figure 4.

Figure 4: *Synchronism no. 6*, pg. 6, s. 2, m. 1



Davidovsky also uses the rhythmic idea shown in Figures 5 and 6 to create tension.

Figure 5: *Synchronism no. 6*, pg. 15, s. 1, m. 3

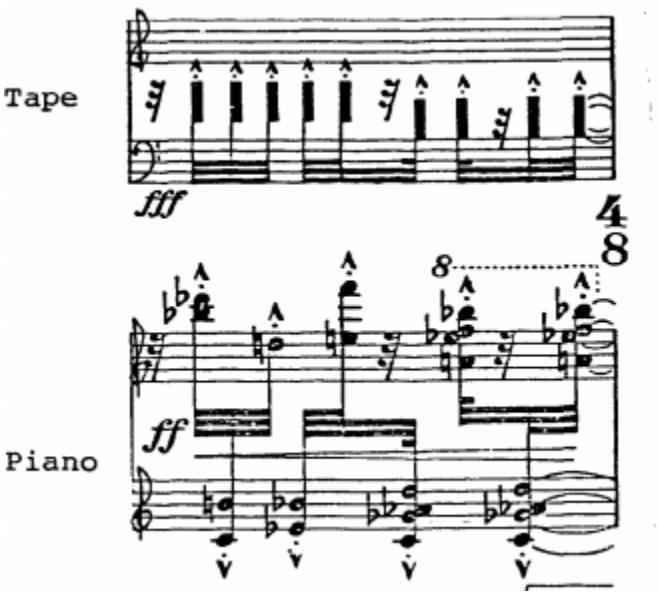
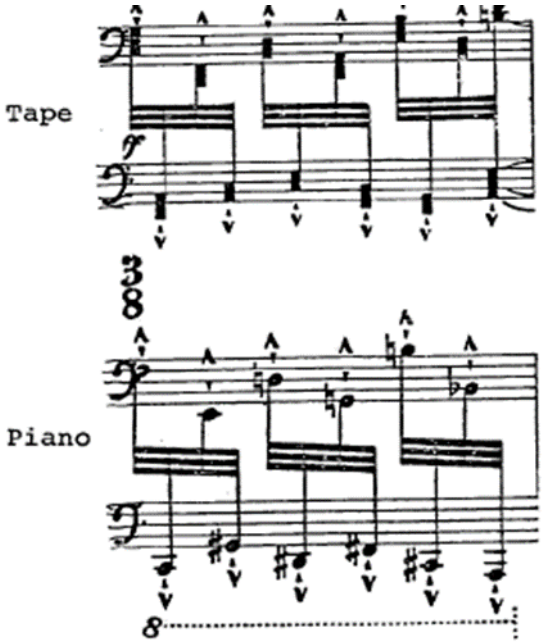


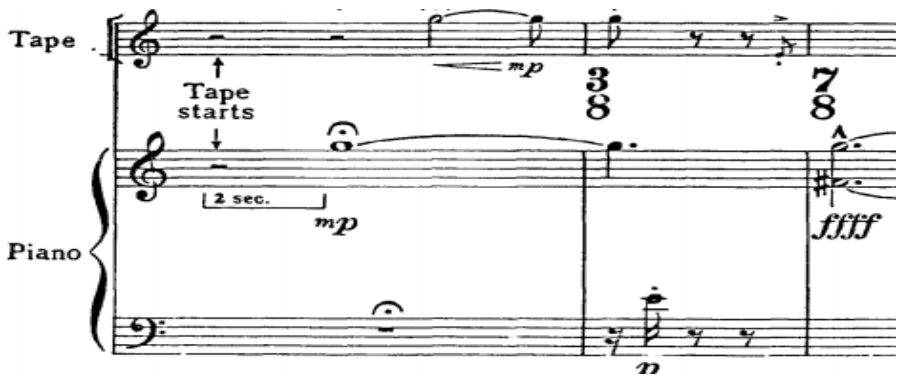
Figure 6: *Synchronism no. 6*, pg. 18, s. 1, m. 2



Timbre

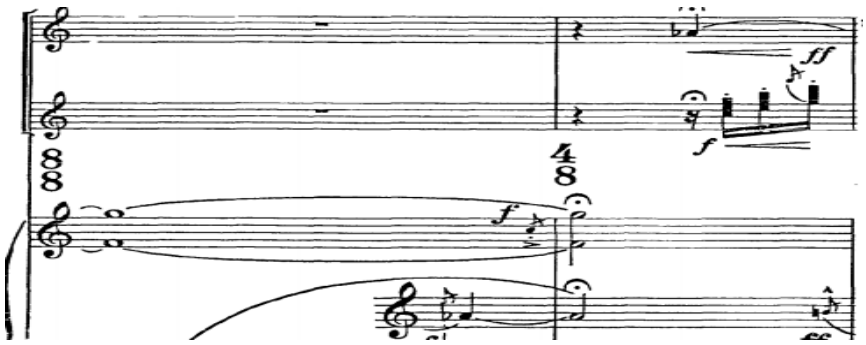
Davidovsky also uses timbre modulation techniques throughout *Synchronisms no. 6* to increase the integrity and secure the stability of harmony. In the piece, the opening sustained G is transferred from the piano to the tape part and the G in the tape sustains over the rapid decay of the piano tone with a slight decrescendo causing a timbral shift. This vertical unison and the tenth between the piano and electronic tape create a feeling of harmonic stability but it is quickly interrupted by the F-sharp in the following measure as shown in Figure 7.

Figure 7: *Synchronisms no. 6*, pg. 3, s. 1, mm. 1-3



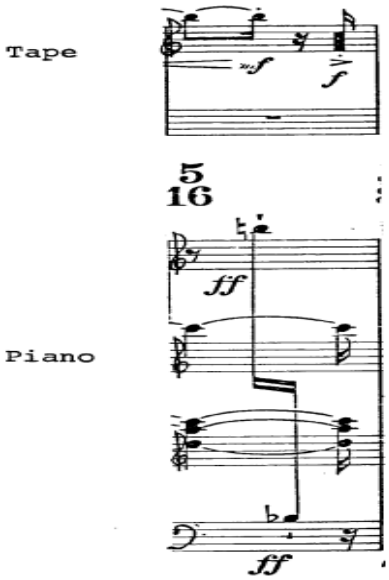
This technique reappears in measure 6 as the tape adds a crescendo to the decaying A-flat in the piano (see Figure 8).

Figure 8: *Synchronisms no. 6*, pg. 1, s. 2, mm. 1-2



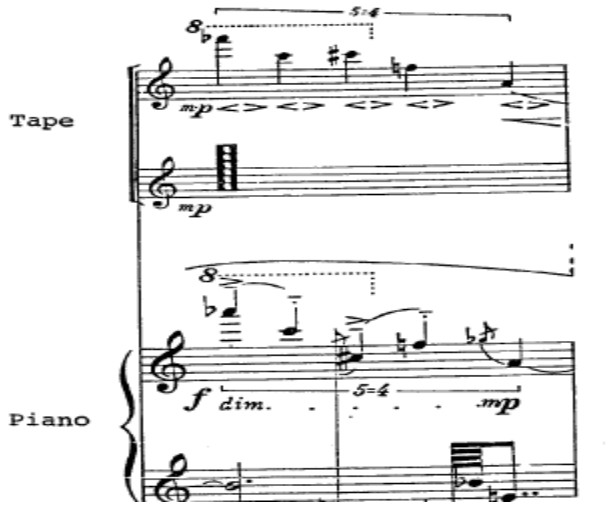
There is another timbral shift in measure 15 (see Figure 9). The B-natural in the piano part is reproduced after rapid decay in a tape (a unison) with a sharply accented attack and fortissimo dynamic marking.

Figure 9: *Synchronisms no.6*, pg. 4, s. 2, m. 4



Unity is created between the piano and tape part through precise alignment of both pitch and rhythm as shown in Figure 10. These gestures create a homophonic texture that helps to change the piece's energy

Figure 10: *Synchronisms no.6*, pg. 7, s. 2, m.1

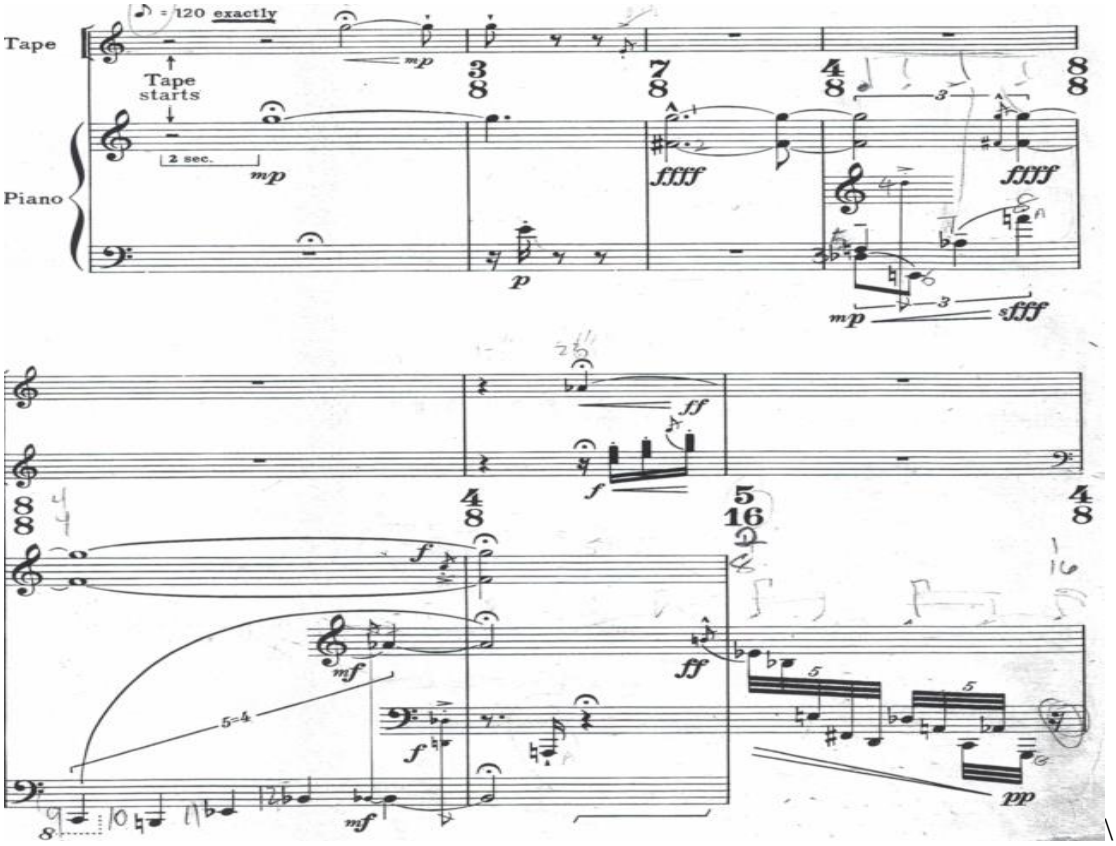


The climax of *Synchronisms no.6* includes unity and tension materials by combining the short tremolo motive with the same repeated pitches from measure 5. E-natural replaces the original E-flat and is marked ***sffff***. The tension of the climax continues until the end of the entire piece. The use of triplets in a contrary motion and doubled tone clusters in both parts act as a percussive sound, creating an indication of climax (Figure 2).

Pitch

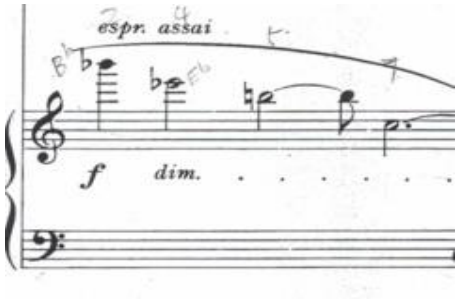
Although Davidovsky did not rely on strict twelve-tone techniques, he does use a tone row and its transformations periodically. P0 appears first in measures one to five (G-F#-Db-D-F-E-Ab-A-C-B-Eb-Bb) and the retrograde R0 is used later. The tone row P0 is indicated in Figure 11 below.

Figure 11: *Synchronisms no.6*, pg. 4, s. 1, mm. 3-5



The pitch content of the tone row does not play an important role in *Synchronism no.6*, but the horizontal motivic idea recurs consistently in audible forms. This technique reinforces motivic unity while also adding dynamic variety. Davidovsky uses the ascending notes C-B-Eb-Bb in the bass clef from the row P0 (shown in Figure 11) as a motivic idea, that reappears as an exact pitch retrograde with a descending version on page 5 (shown in Figure 12).

Figure 12: *Synchronisms no.6*, pg. 5, s. 2, m. 1



Further pitch unity is employed through similar timbral qualities in both the piano and tape. The samples Davidovsky uses on the tape resemble tones, harmony, clusters, and other piano sounds. For instance, the beginning pitch in the tape resembles the piano sound (shown in Figure 11).

Extended Techniques

Later in the piece, techniques such as plucking and muting the piano strings are used to imitate the electronic effects, thus integrating the acoustic and electronic sounds. The rapid alternation of buzzy cluster sounds on the tape and individual notes on the piano creates more impactful and striking effects. For example, in the first measure on page 16 and last measure of page 23 (Figure 13 and 14 respectively), Davidovsky plays back the piano's timbre differently, which focuses the listener's attention to the percussive and mechanical elements that were previously unheard.

Figure 13: *Synchronisms no.6*, pg. 16, s. 1, m. 1

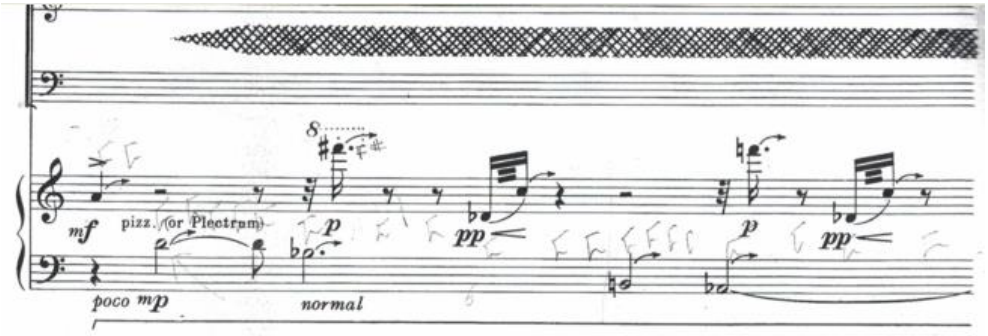
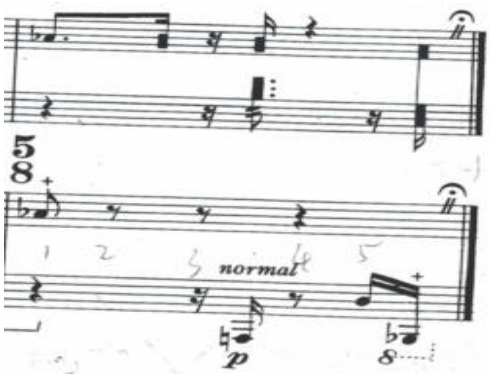


Figure 14: *Synchronisms no.6*, pg. 23, s. 3, m. 4



Davidovsky created the tape arrangement by synthesizing electronic sounds and using tape-editing techniques. In several passages, he used the delay effect to create a clangorous sound, reminiscent of a pinball machine (shown in Figure 1). He geared the editing techniques more towards manipulating the pitch, timbre, rhythm, dynamic, short motives, and duration. *Synchronisms no.6* is an example where the audience can see and hear the piano within the perspective of electronic music. Although the piece is now most often performed using CD accompaniment (rather than magnetic tape), this work ultimately led many performers and artists to combine synthesis and acoustic elements in music to find their own sound.

Practice Suggestions and Performance Requirements

For pianists who are unfamiliar with electronic music scores, electronic music recital program preparation is a challenge as synthesis and rhythmic synchronization serves as a new technique. Even in electronic music, the traditional way of practicing, including as slow tempo practices, outlining sketches of phrases or sections, grouping practice, and small sections practice is greatly beneficial. The basic breakdown of my practice included marking the divisions on the score, picking out all of the solo piano phrases, and calculating the amount of time on tape part time between sections. For instance, the lapsed time between page 5 and page 6 is twenty-one seconds and it required me to practice with a timer until the performance. By preparing this piece like a conventional piece, I was able to see the overview and decide how to locate the solo piano lines.

It is important that through practice, the performer becomes comfortable with the tape and assimilates the proportional relationships of the tape. Because the common materials and unifying characteristics are used throughout the piece, I recorded all the unison elements including chords, clusters, rhythmic patterns, triplets, and tremolos on the tape part and added them to Audacity (a computer program using for editing and importing the existing audio files). This process allowed me to practice through Audacity at a very slow tempo and gradually speed up to the performance tempo. Once I was comfortable with the piano part, it became very important to listen to the tape alone while reading the whole score. This type of score study allowed me to focus on the pre-recorded parts and develop the auditory sense of how the parts coincide and facilitate the timbral interchanges. The last two pages of *Synchronisms no.6* increase in difficulty because of the extended piano techniques. I added stickers to the inside of the piano to identify the notes of the strings being plucked.

There are several preparations that also need to be set up before performance, and high-quality electronic playback equipment (including a computer or CD player, an amplifier, and loudspeakers) are essential for a successful performance. Location and positioning of the speakers in the hall, setting volume levels, and rehearsing with a tape operator (if required) should be worked out prior to the performance.[10]

[10] Davidovsky, *Synchronisms no.6*.

Chapter III: Jacob ter Veldhuis: *The Body of Your Dreams*

Background and Biography

Jacob ter Veldhuis was born on 14 November 1951 in Westerlee, a small village in Groningen, Netherlands. He studied flute, horn, percussion, piano, and music education at the Groningen Conservatory and later studied electronic music with Luctor Ponse and composition under Willem Frederik Bon. Between 1981 and 1983, ter Veldhuis composed Symphony no.1 for orchestra and five percussionists and the Northern Philharmonic Orchestra premiered the work.[11]

Ter Veldhuis wrote three notable compositions between 1986 and 1991 and *Insonnia, Drei Stille Lieder,* and *Diverso Ii Tempo* were all well received by the avant-garde. He was hired by *Darmstädter Ferienkurse* as a composer but he did not enjoy working there, remarking that it was "Not so interesting: I did not feel at home there. I did a lecture recital which was misunderstood. But it shaped my career. After Darmstadt I knew this what not what I wanted."[12] As he began to understand his own style, ter Veldhuis described his wrok as "avant-pop."[13] Ter Veldhuis wanted to create new music for a larger audience and he started using samples of human speech to transmit messages in both tonal and modal contexts. He created the term "boombox repertoire" that encompassed American pop culture, music, television, and current events.[14] This was a major turning point in his career.

[11] "Veldhuis, Jacob ter," Donemus, accessed April 12, 2016, https://webshop.donemus.com/action/front/composer/Veldhuis%2C+Jacob+ter.
[12] Zachary Pischnotte," The Saxophone Music of Jacob ter Veldhuis: A Discussion of *Pitch Black, Garden of Love*, and *BUKU*," (DMA diss., University of Kansas, 2016), 9. http://search-proquest-com.www2.lib.ku.edu/docview/1819568903?accountid=14556.
[13] "Veldhuis, Jacob ter," Donemus.
[14] Ibid.

Ter Veldhuis frequently incorporated jazz, hip-hop, funk, rock and African-American vocal samples into his classical techniques grounded in minimalism. For example, his composition, *Le Soupirs de Rameau* (1995) was composed for the harpsichord but included rock music samples. He described his style of composition as writing the music he wanted to hear for himself because "that music did not exist."[15] He set out to write accessible music that was "engaged in society."[16] The *New York Times* acclaimed that "His boom box pieces, for recorded tape and solo instruments, [were] analogous to Tom Wesselmann's slick collages, limning the outlines of larger-than-life American figures in a pop idiom."[17] Because ter Veldhuis's music linked the features of classical styles to pop and jazz, his compositions were performed by many well-known both orchestras, including The Royal Concertgebouw Orchestra, Tokyo City Philharmonic, Rotterdam Philharmonic, Russian State Academy, Düsseldorf Symfoniker, the Metropole Orchestra, and Nederlandse Reisopera and soloists including Branford Marsalis, James Galway, Evelyn Glennie, and Ronald Brautigam.[18]

The Body of Your Dreams was composed in December 2002 and was commissioned by *Deutschlandfunk* for Kees Wieringa. It was first performed and recorded on March 15, 2003 with later revisions the following year. *The Body of Your Dreams* uses remixed tape containing an American television advertisement of a slimming weight-loss belt. The pitch and rhythm of each and every piano tone in this piece is determined by one-liners from the commercial.[19] Ter Veldhuis's idea of using human speech technique was inspired by Steve Reich's tape experiments from the mid-1960s, which were an important development for both minimalism

[15] Pischnotte, "Te Saxophone Music of Jacob ter Veldhuis," 10.
[16] Pischnotte, "Te Saxophone Music of Jacob ter Veldhuis," 10.
[17] Anne Midgette, "Dutch Composer Samples Pop Culture and Gives It a Melody," *New York Times*, May 4, 2007, http://www.nytimes.com/2007/05/04/arts/music/04jaco.html?_r=0.
[18] "Veldhuis, Jacob ter," Donemus.
[19] ter Veldhuis, Jacob. *The Body of Your Dreams*. Amsterdam: Boombox Publishing, 2002.

and electronic music. Two looped recordings of the same vocal sample are played in Steve Reich's *It's Gonna Rain* (1965) and *Come Out (*1966) using slightly different tempos so that the samples fall out of phrase with each other until they re-synchronize at the end of the piece.[20] The vocal phrase repetition technique associated with minimalism is used in *The Body of Your Dreams* and ter Veldhuis also adopted pop music elements, percussion, guitar and syncopated rhythms into this piece.

Form

The overall formal idea of the 8'35" long work can clearly be divided into sections by sudden dramatic shifts in texture, words, meter and harmonies. The form is outlined in Table 2.

[20] Nick Collins and Julio d'Escrivan Rincón, ed., *The Cambridge Companion to Electronic Music* (Cambridge: Cambridge University Press, 2007), 44.

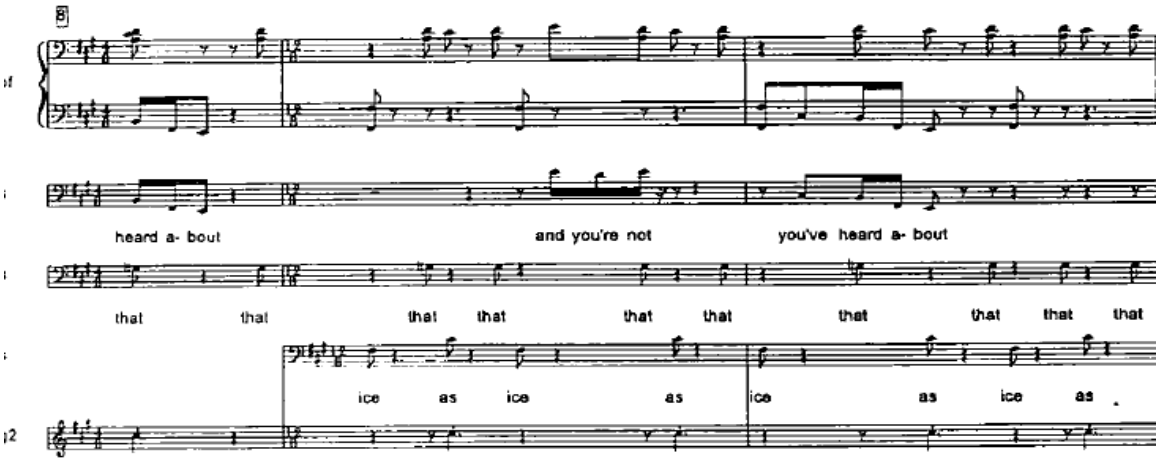
Table 2: Form of *The Body of Your Dreams* by Jacob ter Veldhuis

Division	Texture/characteristics	Speech	Modality/Harmony	Tempo/Meter
Mm. 1-62	Staccato in the voices and piano part present a polyphonic texture	"Now you ready to hear about the latest evolution…that cellulited flabbiness oh wow!"	F#- Aeolian; m. 40 change to E-Dorian	Mostly in triple meters (12/8); minimalism-like; use of repeated patterns
Mm. 63-114	Begins with legato in polyphonic texture, staccato returns and the detached sounds repeat at the end of the section with a dramatic sonority	"You're just kicking back, relaxing, that's right…triggering the muscles".	m. 63, C-Aeolian; m. 72 E-Dorian; m. 84 C-Aeolian; m. 92 transition begins with F-Dorian; m. 96 Db-Ionian; m. 103 F-Mixolydian; m. 112 E-Dorian	Mostly quadruple meters (4/4); quintuple meter (5/4) occasionally
Mm. 115-168	Still polyphonic, shift to homophonic texture at climax; texture gets thicker mm. 164-168 with pedal point; loud dynamic throughout	"I huh prefer the in preparation for competition…. champion body builders! Wow, that's incredible."	Begins in F#-Aeolian; mode shifts to C-Aeolian in mm.122-123; mm. 124-125 transition to Eb- Mixolydian; m. 126 E-Dorian; m. 138 C-Dorian; m. 142 F-Ionian; m. 151 F – Mixolydian; m. 164 F-Ionian	Quadruple meters
Mm. 169-226	Polyphonic texture; lighter sonorities; rapid sixteenth notes	That's…that's…. that's incredible! You are not down on the floor…. that's the body of their dreams, with no sweat! That's incredible! How can you how can you beat it!	Begins in D-Mixolidian; m. 221 transition to F-Ionian; m. 230 C-Aeolian; m. 237 G-Ionian; m. 243 D-Mixolydian	Sixteenth notes dominate this section with driving rhythms; frequent meter changes
Mm227-end	The shortest section; polyphonic texture	"How can you beat it...the body of their dreams…"	Begins in D-Aeolian; m. 262 to end E-Locrian	Frequent meter changes; unstable ending

Texture

Ter Veldhuis based his music on speech and made the tape to fit his own conception of speaking. In the first section, there are three voice parts (two female and one male) that start at the beginning. The female voices create a steady beat repeating, "that that." Meanwhile, the male voice states the main lyrics and rounds out the ensemble. Once the voices have established the beat, the piano enters in measure 4. The right hand imitates the female voices while the left-hand mimics the pitches contained in the spoken male dialogue. As shown in Figure 15, ter Veldhuis combines the voices with the piano to create a polyphonic texture and provides an ostinato in both parts throughout, presenting minimalism-like characteristics.

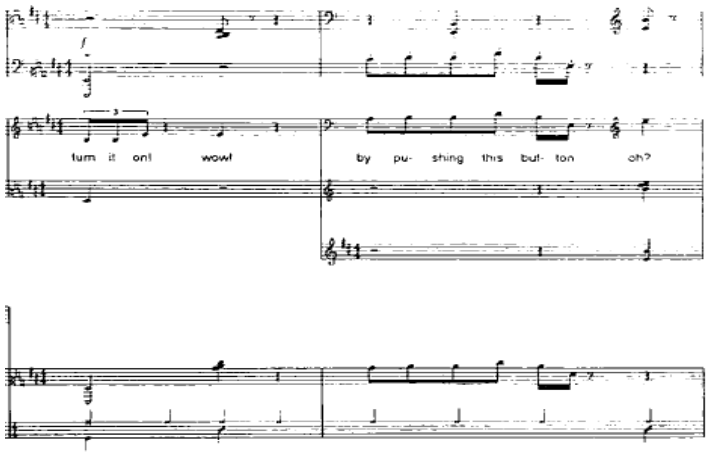
Figure 15: *The Body of Your Dreams*, mm. 8-10



Synthesizer and guitar are present in the tape as well. In measure 50, ter Veldhuis introduces a bell-ringing sound that is doubled by the piano. As the texture gets thicker, tenuto marks are added and more vocal layers occur in the tape. Stress and tension grow with the words, "you can feel the contraction…you can feel–that celluloid flabbiness...and you watch the body of your dreams."

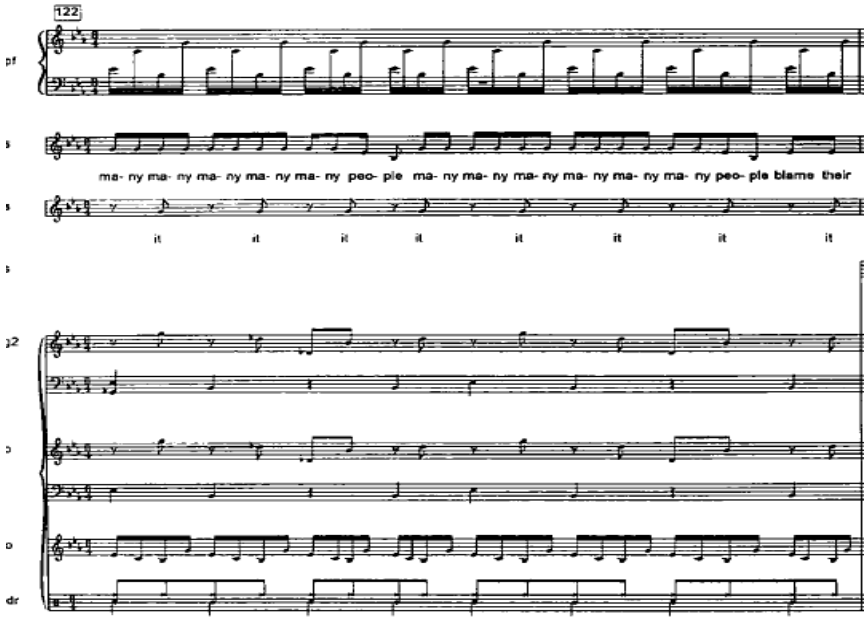
The tension is relieved in the beginning of the second section. The mood and tonality change as the voices present, “you’re just kicking back, relaxing, that’s right.” Measure 72 is a turning point as the words “turn it on!” coincide with the entrance of the drum set (comprised of 2 crash cymbals, hi-hat cymbal, snare drum and tom-toms). The tape and piano parts present a homophonic passage but quickly change back to the polyphonic texture shown in Figure 16.

Figure 16: *The Body of Your Dreams*, mm. 72-73



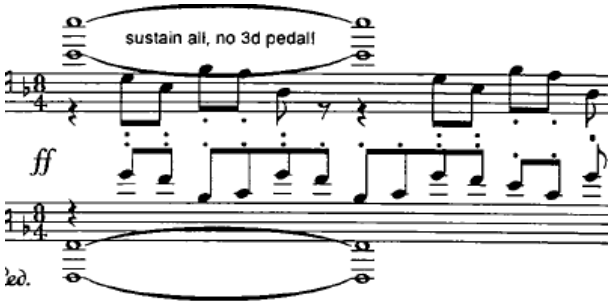
At measure 81, the pianist plays parallel octaves and employs the sustaining pedal to build the intensity with a loud dynamic marking. The dynamics support the words, “working you out, working you out”, and tension increases until the end of the second section. Ter Veldhuis uses sixteenth notes in measure 120 with the tape doubling the piano to create a driving rhythmic section with a dramatic crescendo (Figure 17).

Figure 17: *The Body of Your Dreams*, m. 122



The stress and tension continue to build and with a jubilant sound, "3000 contractions in just 10 minutes! And now: get ready! Champion! Champion body builders!" is heard on the tape. The climax is reached at measure 164 (shown in Figure 18), as all parts except the male voice are unified.

Figure 18: *The Body of Your Dreams*, m. 164



A lighter section, using rapid sixteenth notes throughout quick meter changes, follows the climax. The softest dynamics occurs in this section when the voices state, "which I usually have

a problem wearing pants like, I've had a bad problem with this huh love handles on the side." As the tension resolves, the same climactic patterns returns at the end of this section, with an emphasis on the incredibility of the product.

The final section is the shortest and returns to a polyphonic texture with a simple and thin sonority. Even though the final section is brief, there are many tempo and meter changes with many ties across the bar lines. This presents a syncopated ending with bell sounds in both parts that compliment the initial phrase, "now you're ready to hear about the latest evolution in the fitness phenomenon: the body of your dreams...it's super comfortable and super durable...the body of their dreams..."

Practice Suggestions and Performance Requirements

The Body of Your Dreams is challenging to play because ter Veldhuis composed the piece with polyphonic textures and frequent meter changes. Fortunately, the piece is strictly quarter note equals 136 beats per minute (bpm), thus using Audacity or other editing program is recommended. The metronome can be set to 272 for the eighth-note subdivision and the tempo can be adjusted gradually for slow practice. There are six audio tracks provided that include the overall recording and divided sections for the pianist to practice. Practicing the piano part alone with a metronome, the performer can learn the work like any other piano solo piece. The performer should also work to project energy and body movements that support the words and dynamics.

Chapter IV: Christopher Cerrone: *Hoyt-Schermerhorn*

Background and Biography

Christopher Cerrone was born on 5 March 1984 in Huntington, New York. He received an undergraduate degree in composition from the Manhattan School of Music where he studied with Reiko Fueting and Nils Vigeland.[21] Cerrone went on to earn his master and doctoral degrees from the Yale School of Music, where he worked with David Lang, Christopher Theofanidis, Martin Bresnik, Ingram Marshall and Ezra Laderman. He has also collaborated with many well-known composers including Pierre Boulez and Salvatore Sciarrino. In 2014, Cerrone was a finalist for the Pulitzer Prize and won the Rome Prize the following year along with several awards from the American Society of Composers, Authors, and Publishers. Cerrone was a founding member and co-Artistic Director of Red Light New Music and is currently a member of the composers' collective Sleeping Giant.[22]

The development of synthesis techniques in the twenty-first century paved a path for creation of interactive software and hybrid instruments to explore the further possibilities of early electronic instruments. *Hoyt-Schermerhorn* by Christopher Cerrone makes use of computer software to amplify and alter the piano sounds.[23] The work was composed for Yegor Shetsov who worked with Cerrone on a solo piece at Red Light New Music. Named after a subway station in Brooklyn, *Hoyt-Schermerhorn* was composed based on a New York City night-scape and explores Cerrone's emotions of nostalgia, anxiety, joy, and panic. *Hoyt-Schermerhorn* was

[21] "S01E23 – Christopher Cerrone," Greenroom Conversations: The Process Unplugged, updated March 16, 2015, http://www.greenroomconversations.com/?p=280..
[22] "Red Light New Music Plays Christopher Cerrone Review*," New York Times*, October 7, 2011, http://www.nytimes.com/2011/10/07/arts/music/red-light-new-music-palys-christopher-cerrone-review.html; "Sleeping Giant Collective and the Albany Symphony – New Music USA," New Music USA, updated March 23, 2015, https://www.newmusicusa.org/projects/sleeping-giant-collective-and-the-albany-symphony/; Adrianne Koteen, "Under the influence: Deviant Septet commissions Sleeping Giant," I Care If You Listen, updated June 6, 2012, https://www.icareifyoulisten.com/2012/06/under-influence-deviant-septet-commissions-sleeping-giant/.
[23] Christopher Cerrone, *Hoyt-Schermerhorn* (Brooklyn, NY: Outburst-Inburst Musics Brooklyn, 2010).

originally conceived as a graphic score and the pianist was given a choice to choose different sonorities at the beginning of the piece. The current score only utilizes graphic notation in the second half of the work. According to Cerrone's specifications, a chorale-like section appears midway through the piece. He aims to capture a kind of automatic and instinctive structure. However, his design emphasized an improvisatory and aimless structure. The piece is later transformed to a soft and gentle lullaby with occasional fragmented electronic sounds interjecting into the quiet sonority.

An essential element of the piece is Cerrone's use of Max/MSP to create live interaction between the piano and computer in performance. Max, a visual programming language for music and multimedia, was developed by Cycling' 74 (Cycling' 74 continues to maintain it). It shares libraries with users that contain most routines and allows users to use programming interfaces to develop new routines. The data-flow system is the basic language of Max and it uses arrangements of building blocks to patch or add a visual canvas to sound design. The six basic atomic data types: int, float, list, symbol, band, and signal, allow messages to be transmitted from object to object. Becoming familiar with the vocabulary and functions in the patcher is the main way to learn Max. Max can be used to add effects and create audio files for compositional and live sets.[24] In *Hoyt-Schermerhorn,* Cerrone uses Max/MSP to control amplification, reverb, and to trigger a unique granulation effect in the piece's coda.

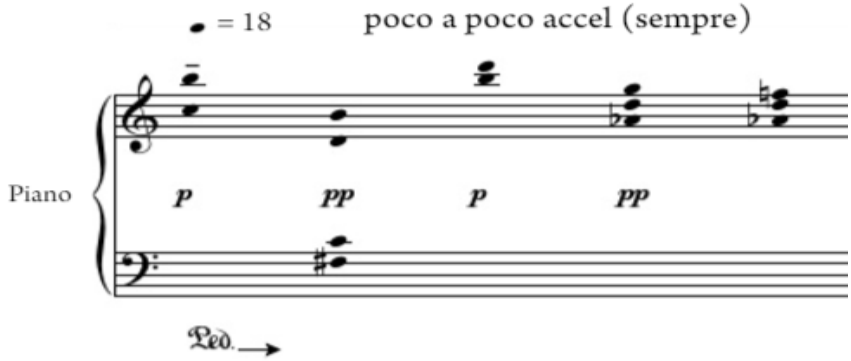
Overview

Hoyt-Schermerhorn was composed around harmonic intervals and chords. The score does not include bar lines but there are several tempo markings to indicate the beginning of each

[24] Time Place and Trond Lossius, "Jamoma: A Modular Standard for Structuring Patches in Max," updated 2006, 143–146, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.501.8865&rep=rep1&type=pdf.

phrase. The piece uses quarter notes as the pulse throughout, however the notes are written on the score without stems. As shown in Figure 19, Cerrone suggests that the tempo is rhythmically free.

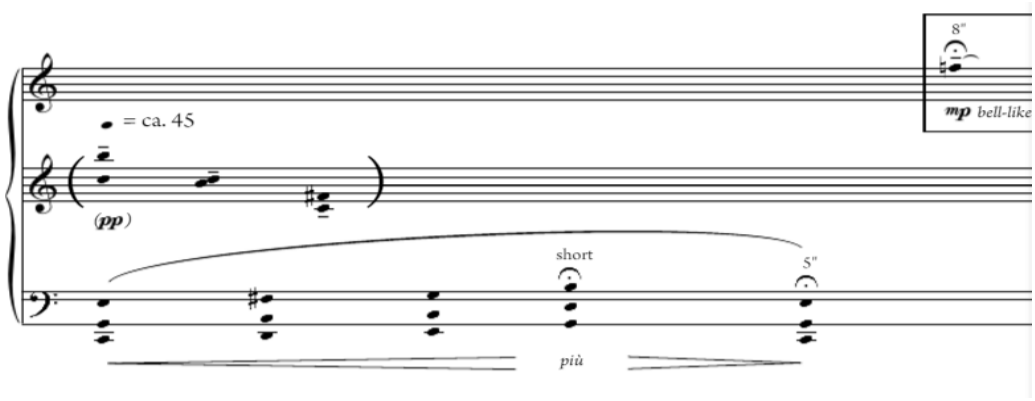
Figure 19: *Hoyt-Schermerhorn*, pg. 1, s. 1



The piece starts begins with a very slow tempo marking (see Figure 19) and gradually increases speed throughout the piece. The tempo reaches quarter note equals 45 bpm at the second system on page 2 before slowing to 35 bpm at the third system of page 4, and finally adjusts up to 40 bpm for the remainder of the piece. The form emerges from the tempo changes and divides the work into two sections. The texture and harmonies also demonstrate clear two-part ideas as well. Cerrone uses the interval of a major seventh (C to B, shown in Figure 19) with a tenuto marking as a reoccurring figure. The first section extends from the beginning to the fourth system on page 2 and establishes a chordal section where harmonies at various dynamic levels create an unstable atmosphere. The opening intervals of a major seventh and augmented fourth (C to F-sharp) are included here to stabilize the harmony. As the tempo accelerates, the texture thickens. When the tempo reaches 45 bpm, it introduces the next section where the non-stop three pairs of notes are introduced and then that motive is repeated in the left-hand as shown in Figure 20. At the beginning of the second section, the motive gradually shifts back to the right

hand while the left hand plays a steady chord progression. Additional layers are added polyphonically to the top, generating a bell-ringing sound effect.

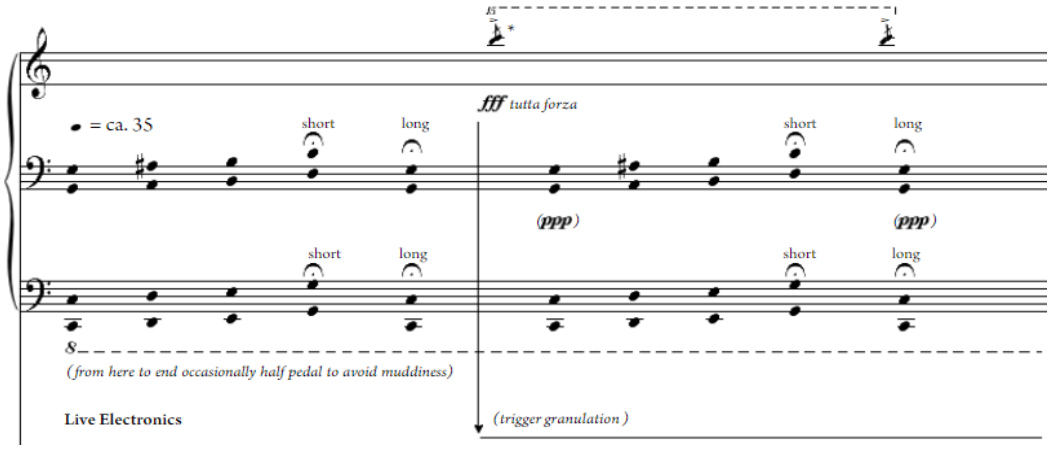
Figure 20: *Hoyt-Schermerhorn*, pg. 2, s. 3



The harmony in the left hand of the second section becomes more stable as Cerrone uses parallel ascending tenths centered around C as the tonal center.

Live electronic sound starts at the beginning of fourth system on page 4 by trigging the granulation button on Max until the end of the piece. Shown in Figure 21, there is a shattering sound that coincides with high pointed attacks in the piano that are also looped in the patch.

Figure 21: *Hoyt-Schermerhorn*, pg. 4, s. 3



Practice Suggestions and Performance Requirements

The hardest part of performing this piece is playing in three different tempos while both hands have to deal with multiple layers of melodic material. Physically, the extended passages of parallel tenths are very challenging for pianists. The fermatas allow some flexibility and space for pianists to highlight different melodies. The chord progressions can be rehearsed with a metronome while calculating approximate timing for playing the bell-sounds over the progressions.

The performance of this piece requires two high-quality microphones, two loudspeakers, a laptop running Max 6 Runtime, and an audio interface with the capability to expand and improve the sonic capabilities of a computer and integrate the electronic and acoustic elements of the composition.[25] Quarter inch cables and an XLR connector are also needed to connect the audio interface, computer, and microphones. All amplification levels and other synthesis parameters should be set before the performance. Unlike conventional pieces, this is often performed with the lights dimmed or completely turned off in the concert hall. The peaceful environment and the way the amplification and reverb envelop the audience in sound, create a peaceful and meditative experience for all.

[25] Sam Mallery, "Audio Interfaces," Explora: News, Tips and Reviews, updated 2012, https://www.bhphotovideo.com/explora/audio/buying-guide/audio-interfaces.

Chapter V: Conclusion

Synchronisms no. 6, *The Body of Your Dreams*, and *Hoyt-Schermerhorn* demonstrate the evolution of electro-acoustic piano music in the twentieth and twenty-first centuries. Although the field of electronic music is more than a century old, electro-acoustic music for the piano is still a growing genre, as is demonstrated by these three pieces.

Synchronisms no.6 embodies the style of early pre-recorded music using simple synthesized electronic sounds that cooperate with the piano and creating a pointillistic texture. *The Body of Your Dreams* approaches the performance of electro-acoustic piano music similarly by using traditional fixed media but Jacob ter Veldhuis's interest in contemporary culture add another layer of intrigue to his work, as his fixed media incorporates repeated human voices and harmonies informed by multiple genres. As technology developed and analogue music gave way to the digital world, more musicians began to use live electronic performance instead of pre-recorded tape, as shown in *Hoyt-Schemmerhorn*, which separates itself from the two former pieces with its live processing, enabling the performer to entirely change the sound of the piano. These three pieces not only portray the progression of electro-acoustic piano music throughout the twentieth and twenty-first centuries, but they also mirror the advancement of audio technology, as composers continuously pushed for new sounds using every available device at their disposal.

Presently numerous composers and pianists around the world are using the once novel technologies of sound editing and electronic synthesis. The potential of electronic music continues to grow exponentially as computing power rapidly expands, more efficient programs are created, and multi-media elements integrating aural, visual, and other sensory elements using powerful organizational systems are explored. Implications of such rapid technological changes

are complicated, as unforeseen factors such as changes in consumer habits have also been impacting the music industry. Electro-acoustic piano music is still young and it is difficult to tell how many of these pieces will be received by audiences in the future. With the endless possibilities for the creation and manipulation of sound and the already immense sonic palette of the modern concert piano, composers are certain to produce many masterpieces that offer both a new view of where music has been, and also a glimpse at new artistic mountains to be climbed in the future.

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